VISUAL LANDINGS IN REGIONAL AND LOCAL AIRPORTS

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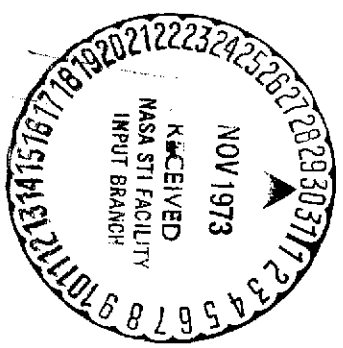

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16. Abstract

The article considers the basic plans for the ground lighting facilities worked up by AEG-Telefunken in cooperation with the German Federal Institute for Flying Safety. The program is broken down into five sections, each section offering recommendations for the different situations found at most regional airports. These sections are 1) lighting the takeoff and landing runways, 2) obstacle lights and beacons, 3) runway beaconing, 4) approach beaconing, and 5) switching and control systems.

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Introduction

The increasing burdens placed on major airports in the German Federal Republic by air freight haulage involves numerous problems for general air traffic, i.e., commercial traffic, private planes, planes flown for amusement, and sports training aircraft. These problems pertain to difficulties in dispatching the planes at landing and takeoff, and in accommodating and servicing them. Moreover, major airports, which usually lie within the built-up areas of large cities, are only accessible via crowded entrance and exit roads. As a result, the time spent on the road and railway is equal to the airtime on short trips. /34*

The solution to these problems lies in building local and regional airports. We report below on visual landing aids in these "feeder" airports, designed and equipped by AEG-Telefunken.

For years the German Federation, the states, and the communities have been faced with the task of extending existing landing fields or building new airports for night air traffic. In close cooperation with the BFS (German Federal Institute for Flying Safety), AEG-Telefunken worked out a basic plan for the ground lighting facility in question. The starting point was that the individual beaconing sections for a local airport be laid out from the beginning such that extension in stages up to the regional airport is ensured.

1. LIGHTING THE TAKEOFF AND LANDING RUNWAYS

The runway represents the nucleus of an airport. The necessary lighting must therefore be installed in the very first stage

* Numbers in right-hand margin indicate pagination in the foreign text.

of extension construction.

1.1 Beaconing on Runway Edge and Center Line

For an average runway of 1000 m (landing ground) or 1500 m (regional airport) type C1 high-intensity lights were installed about 2 meters from the runway edge, 60 meters apart. They are furnished with 2-0 W 6.6 A incandescent lamps and have proved optimal due to the two-beam optics (Figure 1).

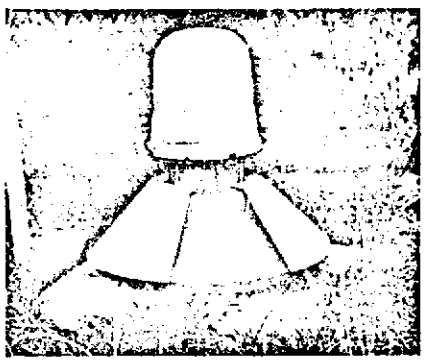
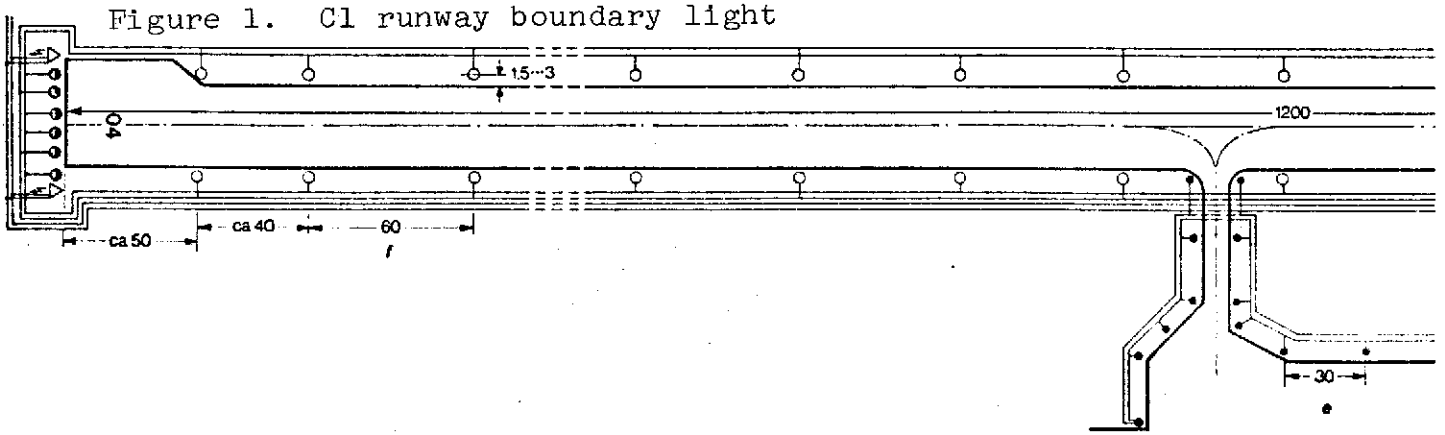


Figure 1. C1 runway boundary light



a--lighted wind direction indicator; b--lighted landing direction indicator; c--tower with revolving lights and obstacle lights; d--station; e--standard measure; can be widened to 60 m; f--standard measure (measurement in meters)

Symbols and Types of Lights:

Runway boundary, C 1, 210 W, 6.6 A, white
Traveled region of runway, C 1, red, white
Threshold 22, C 1, green
Stop 22, C 1, red
Threshold /stop, 04, c L, green, red
Flashing threshold BI 357 L, flash tube, white
Taxiway, R/KHF 51 or KHF 50, 6 V, 35 W, blue

A mechanical and electrical braking coupling connected to the isolating transformer on the feeder side ensures the necessary safety when lights are knocked out by an aircraft leaving the runway.

The boundary lights are supplied in local airports by two, and in regional airports by three separate series circuits. In this way the beaconing configuration is preserved even if only one phase is ready for operation.

In addition to the lights on the boundaries of runways, ducts and connection pipes should be installed in the runway substructure near the drains at the first stage of equipping regional airports, to facilitate subsequent addition of runway center-line lights mounted flush with the runway. Individually switched lights beaming in two directions are in the terminal structure spaced 15 /35 meters apart from one another. Power is supplied by three circuits per beam direction.

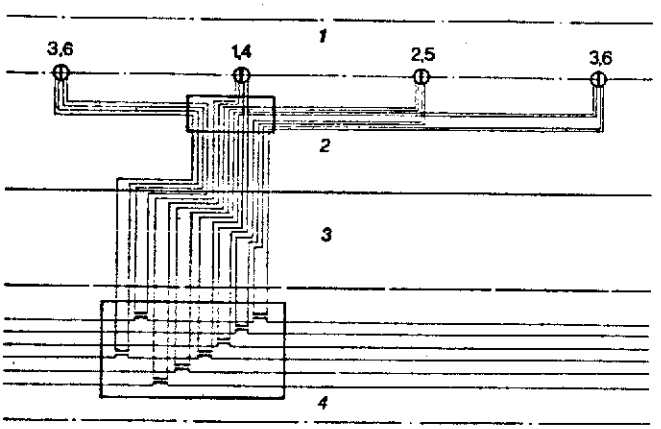


Figure 2. Kassel-Calden regional airports. Planned high-powered center-line lighting. Ducts and pipes already laid. (1) runway center line; (2) junction boxes in lower layer of runway; (3) PVC pipe let into runway; (4) Transformer housing at runway with eight isolating transformers: 250 VA/230 W, 6.6 A/6.6 A.

1.2 Threshhold Lighting

The beginning and end of each runway must be especially marked. Here one distinguishes between threshold lights and end lights,

which bound the approximately 30-meter wide runway of landing grounds or the 45-meter wide runway of regional airports.

In local airports the following safe and inexpensive configurations have resulted: an arrangement of six to eight Cl lights along the 30-meter wide runway such that the red-filtered half beams are an end light in the direction of the airport reference point, and the green-filtered half beams is a threshhold light in the approach direction.

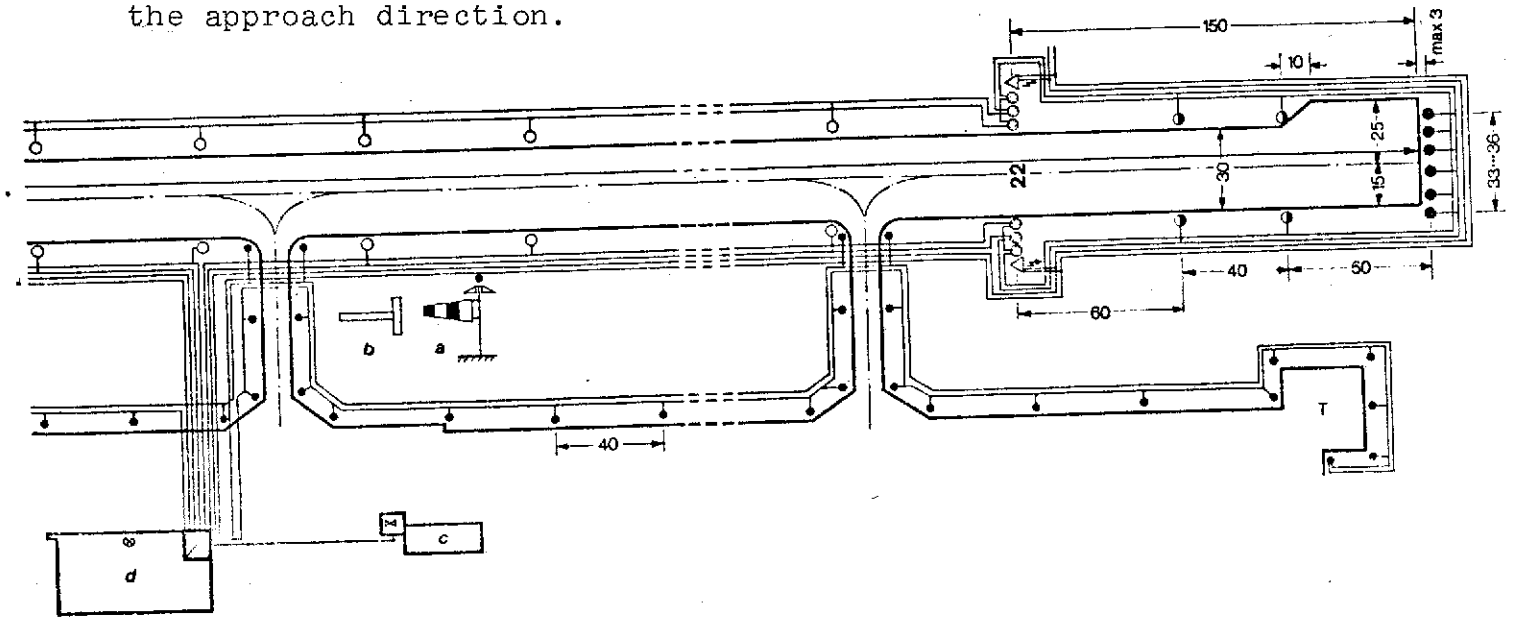


Figure 3. Approach 04 - combined high-power threshold and end lights
Approach 22 - displaced threshold with separately placed high power threshold lights and end lights
Takeoff runway and taxiway boundary lighting

If an existing local airport is being beaconed for the first time, it is usually found that it is bordered by a dense road and railway network. The competent authorities therefore frequently instruct the airlines to alter their flyover altitude. Despite this measure, full utilization of the runway, at least at takeoff, is restricted by the displaced thresholds.

Six to eight Cl lights fitted with 360° red filters mark the end of the runway while the threshold, in the direction of the

airport's displaced reference point, is made distinct by two lines of lights placed to the side of the runway landing strip. For each line three or four green-filtered C1 lights are necessary at a distance of three meters from one another. All boundary lights between the end of the runway and the displaced threshold are to be filtered red as seen from the approach direction (Figure 3).

The end and threshold lights can be supplied from both of the runway boundary circuits. This provides the necessary safety, and the conspicuousness of the threshold for the small machines flying in slowly is sufficient. Extra expenditure on additional cables, supply transformers and switching mechanisms, as required with individual supply, is now unnecessary.

In regional airports the ICAO (International Civil Aviation Organization, Montreal) guidelines for major airports in category 1 apply to the threshold lighting. Both thresholds are made distinct by color and increased intensity.

With a 45-meter runway width, 18 green-filtered type AGH 365 high-power lights are to be mounted at equal distances. Green filters absorb about 82% of the intensity. To offset this loss as far as possible, the threshold lights are provided with 500 W, 24 V incandescent lamps.

Six Type AGZ 33 L red-filtered lights are arranged in the airport reference point direction, staggered by 180° (Figure 4).

[Figure illegible]

Figure 4. High-power approach light AGZ 33 L as end light.

[Figure illegible]

Figure 5. Threshold and end lighting with threshold flashing light.

The 200 W 24 V incandescent lamp can be retained despite an absorption factor of about 85% for red glass, since the internationally used red stop signal is far more conspicuous than any other color (Figures 5 and 6).

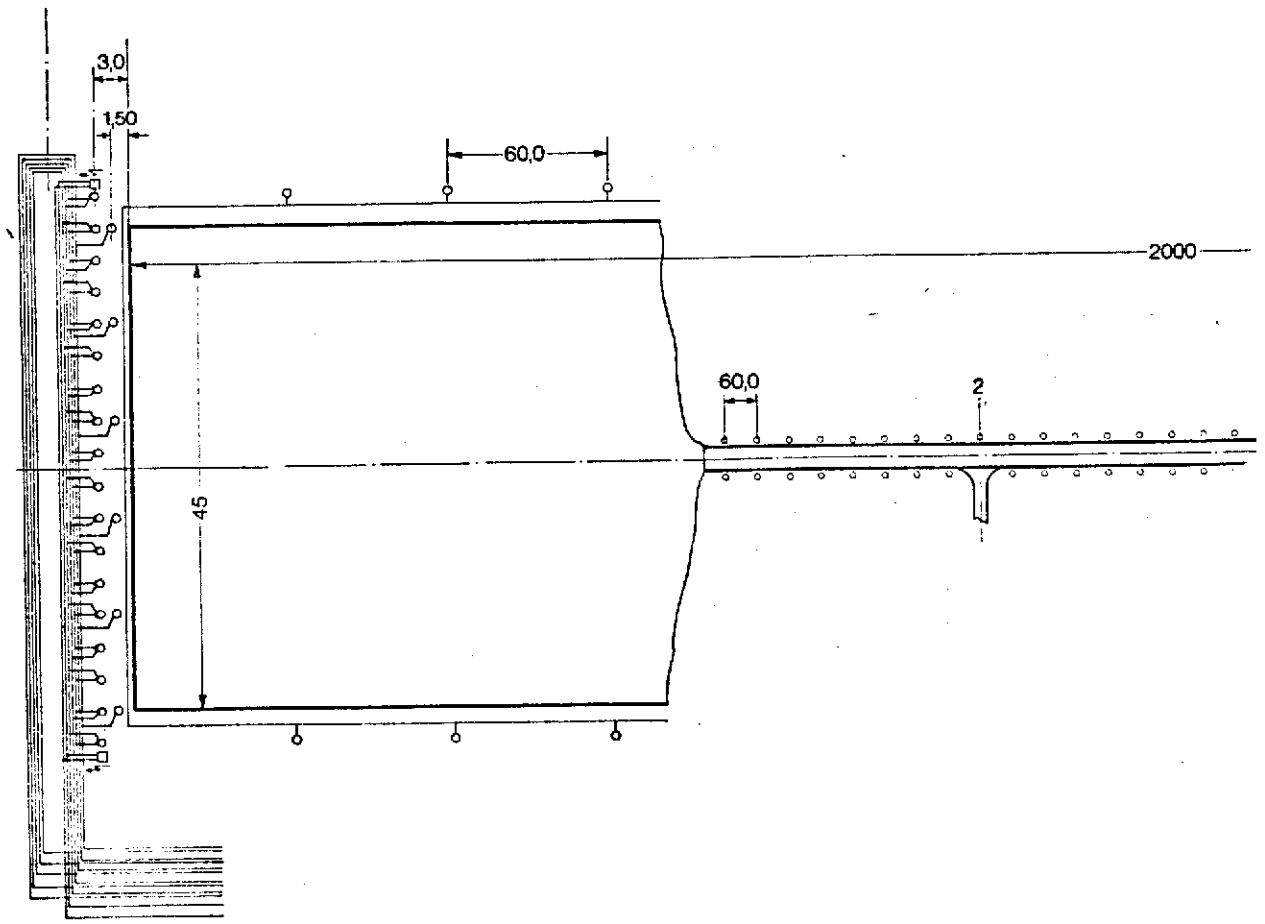


Figure 6. Munster-Osnabruck regional airport.

Approach 07 - High-power and low-power threshold and end lighting

Approach 25 - Displaced threshold with separately-placed high-powered and low-powered threshold and end lighting

Approach glide angle lighting

Approach lighting flush-mounted in taxiways

1--cable runs 2--runway

Regional airports are often confined in extension and cluttered with obstacles, such that here too displaced thresholds are provided. The configuration and manner of operation of the end lighting remains. Twelve AGH 365 lights are set up at the displaced threshold to the left and right of the runway, beaming in the approach direction. In addition, twelve green-filtered AGZ 33 L lights, turned through an angle of 180°, are necessary for the double threshold marking (Figure 6). The boundary lights /36
arranged in the space between the displaced threshold and the runway end are made recognizable with red filters in the approach direction.

The facility is wired according to a unitary principle: both end and both threshold lights are allocated to every second mutually independent circuit. Altogether eight threshold circuits run together into the switching station. This increased expenditure is necessary to comply with safety requirements in regional airports.

1.3 Threshold Corner Flashers

Already in 1967, the AEG acceded to the request of numerous pilots to clearly mark the four corners of the runway strip. Flashing lights of type BL 357 LK were shown by thorough testing to be the best corner lights.

At present these four flashing lights are being successfully used to supplement the threshold lighting in both local and regional airports. A specially-developed switching and control system provides the following operational possibilities:

a. All four lights are on at once and show the position of the runway. If the pilot enters his approach path from a holding pattern or flyover,

b. only the two lights flashing in the direction of his approach are switched on, to mark the beginning of the runway.

Both lights on each runway are designed such that if one /37

light cuts out the otherwill automatically switch on. To supply this threshold flashing light, one four-wire power cable and one at least five-wire control cable are necessary for each approach direction (Figure 5).

2. OBSTACLE LIGHTS AND BEACONS

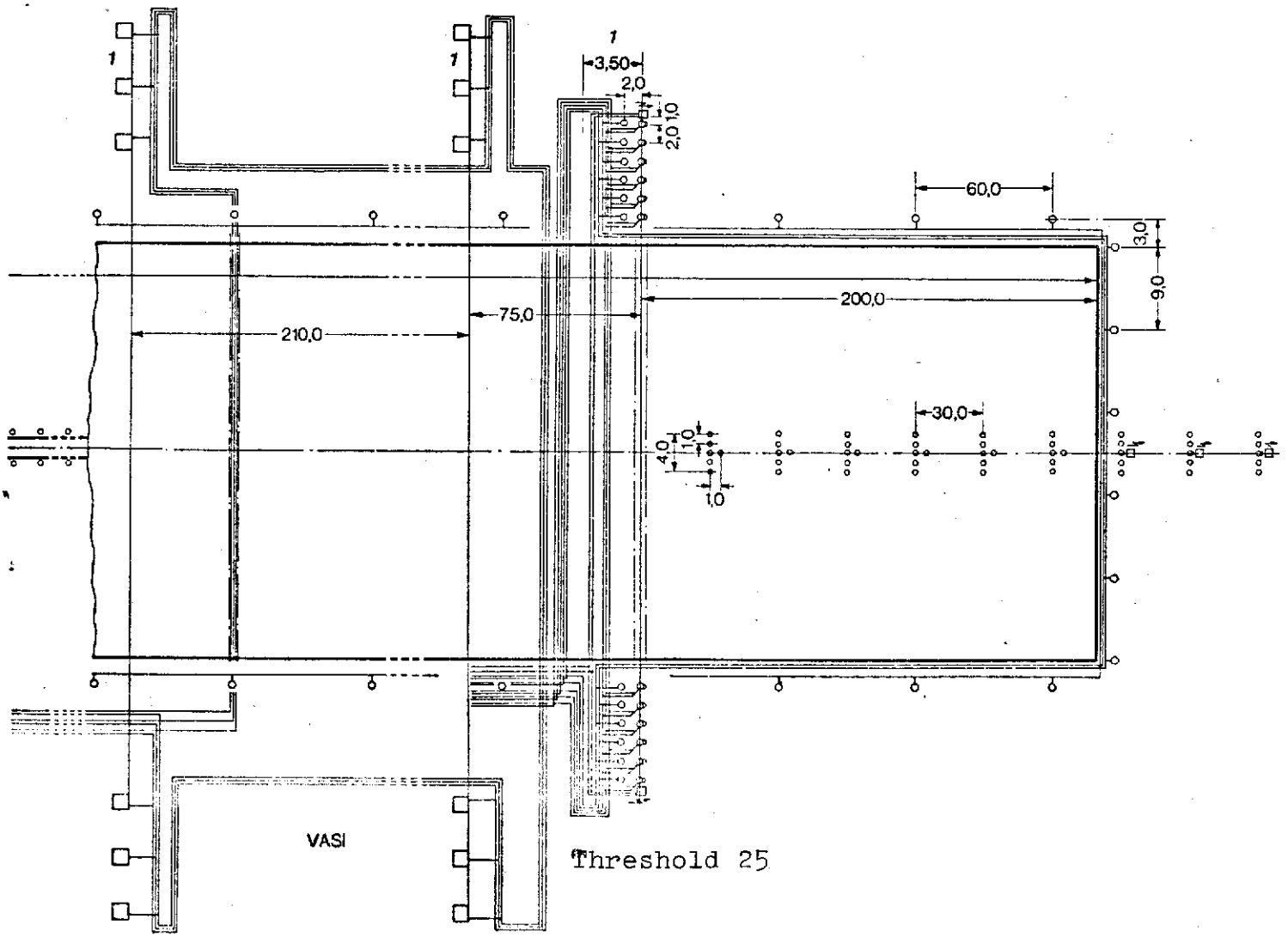
If landing grounds and regional airports are extended in stages, all obstacle lights prescribed by the Federal Institute for Flying Safety must be installed at the same time as the runway beacons.

For marking a KHF 51 red obstacle light is used which, fitted with a 100 W all-purpose lamp, reaches the intensity of 32.5 candlepower required by the Institute. The current can be supplied centrally from the switching cabinet of the substation or from one of the low voltage distributors near the obstacle. Switching and supervision should however be the responsibility of control tower personnel.

The airport beacon can be built either as a double rotating beacon--two rotating projectors staggered by 180° with respect to one another on a gearbox--or as rotating lens light turning inside a stationary 360° projector housing.

The type DDS 20 double rotating beacon, where each projector is fitted with a 200 W 24 V incandescent lamp, is used in local airports. With six revolutions corresponding to twelve flashes per minute and an intensity of 3.2×10^5 candlepower in clear glass plates, the double rotating beacon makes it possible for pilots of small aircraft to find their landing spot without difficulty.

Landing fields and regional airports capable for further development should however be equipped with the bright DL 150 rotating lens light, which when fitted with a 1500 W 55 V incandescent lamp has an intensity of 1.4×10^6 candlepower and comes either with six revolutions (twelve flashes per minute) or ten revolutions (twenty flashes per minute) (Figure 7).



3. RUNWAY BEACONING

All taxiways leading to the runway should be beaconed, if not in the first stage of extension, at least in the next stage.

Since one aims at precise taxiing assistance in darkness and poor visibility, the runway boundary lights should not be placed too far apart. In small landing fields 60-meter spacing is permissible on straight sections if shallow curves have boundary lights every 30 meters and sharp curves at least every 15 meters. Landing fields suitable for extension and all regional airports should however observe the standard: 30-meter spacing on straight /38 sections. This standard also applies to major airports.

The type R/KHF 51 runway light, blue-filtered and with a 40W, 6.6 A incandescent lamp, proves reliable due to its low structural form, particularly on the airports described here. About one meter clear space left between the runway boundary and the light is recommended (Figure 8).

Circuits are distributed according to local conditions: all taxiways are switchable on and off throughout their entire length. In this way the pilot is given the shortest taxiing path from or to the suitable path to the runway.

4. APPROACH BEACONING

According to the guidelines of the Federal Traffic Ministry, runways of at least 900 meters total length should be beaconed in the main-approach direction.

For landing fields, it is considered sufficient for approach

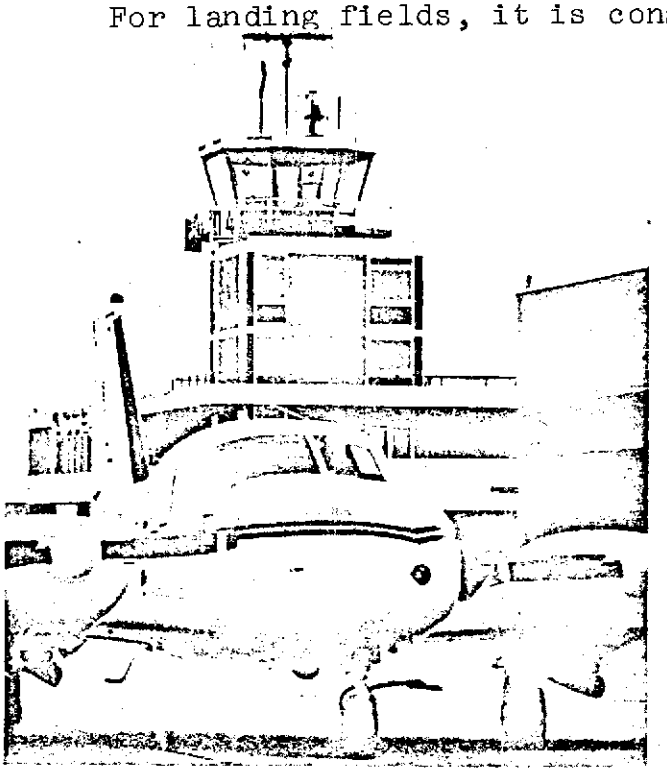


Figure 7. Kassel-Calden regional airport control tower with revolving lens beacon.

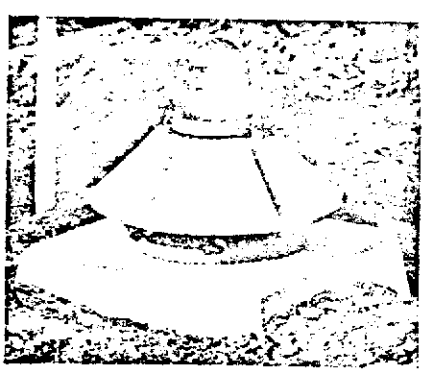


Figure 8. R/KHF 51 runway light.

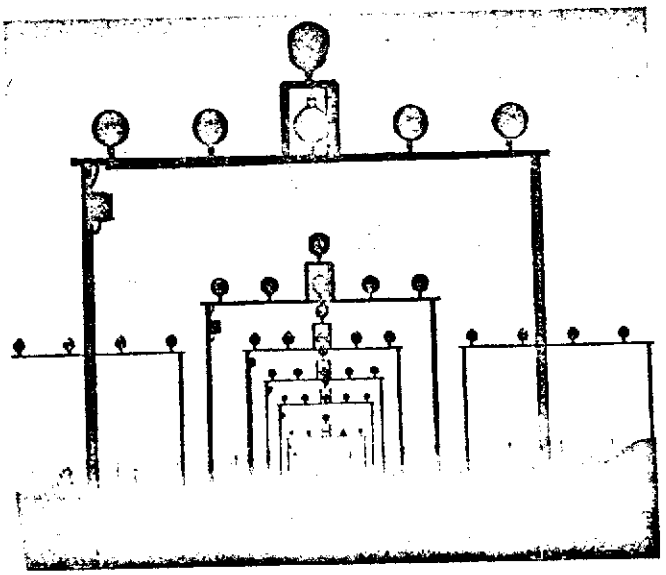


Figure 9. Kassel-Caldren regional airport. Approach lighting with approach lights ACZ 33 L and approach flashing lights BI 357 LK.

marking to be shortened to 420 meters by single white lights of type AGZ 33 L spaced 30 meters apart. The horizon, 300 m from the threshold, should be made distinct by a further six lights placed on each side of the center line.

In later extension stages, such approaches should be extended to the normal length without structural and assembly modifications.

If a displaced threshold is present in the main approach direction of the landing field, the approach beaconing must end at the beginning of the runway, at the height of the end beacons. Power may be supplied by just one series circuit.

Approach beaconing is considerably more expensive in regional airports. The center line lights placed over the entire 900-meter length are provided with an extra white top light with a 40 W,

6.6 A incandescent lamp. Furthermore, on each side of this light another two approach projector of the same type must be provided for building the four-meter wide cross girder. The 300-meter horizon is given from a cross-girder, supplemented by two lines of lights consisting of every eighth approach light (Figure 10).

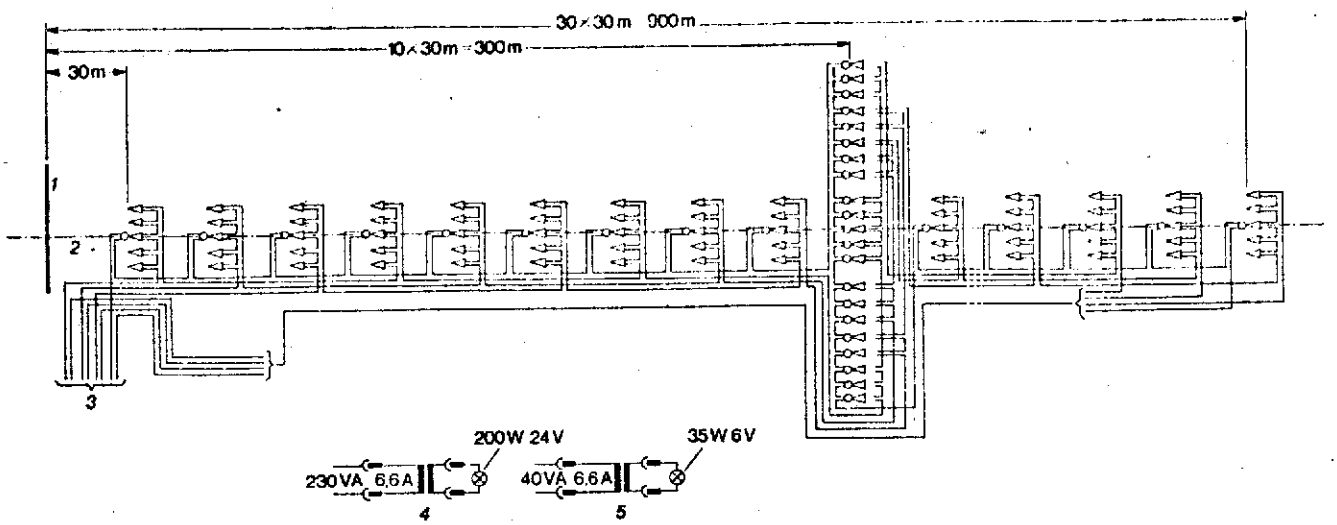


Figure 10. Lubeck-Blankensee regional airport. Approach lighting in operating category 1.

Designation	Circuit	Component	Incandescent Lamps
High-intensity approach	R:22 S:23	56 56	200 W, 24 V, each
Low-intensity approach	T:24 N:25	54 60	35 W, 6 V, each

For completion of the high-power approach beaconing, especially for distinguishing the approach center line, a line of flashing lights consisting of thirty Type BL 357 LK lights is suitable (Figure 9).

Regional airports with displaced thresholds are provided with complete approach in which all approach lights lying between the end lights and the threshold beacons are constructed such that aircraft can travel over them. The cross girders are represented by five single-beam high-intensity lights mounted flush with the runway, each fitted with a 200 W, 6.6 A halogen lamp and an omnidirectional low-intensity flush-mounted light, which includes a 100 W 6.6 A halogen lamp (Figure 6).

In any event the approach line of flashing lights can be extended using the flush-mounted method. This cannot however be made compulsory.

For the landing process, further aid is given for a critical flying phase by building a VASI (Visual Approach Slope Indicators) system. Here, the approach angle of the airport is given visually. Its construction and mode of operation will be explained in a special article.

5. SWITCHING AND CONTROL SYSTEM

Current is supplied to the entire lighting system in the airports discussed here by a switch-and-control cabinet which, together with the (usually separate) transformer structure is built /39 in a centrally-positioned station in the airport precincts.

As well as conventional contractor control, the advantageous plug-in technique with thyristor control is becoming increasingly used, at least in regional airports.

Detailed information on the construction and operation of these plug-in devices and of the control panel associated with them in the control tower will be discussed in a separate report.

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